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EDITORIAL

Foreword to special issue on wave energy conversion

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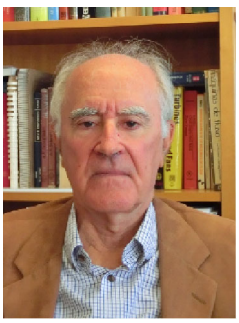

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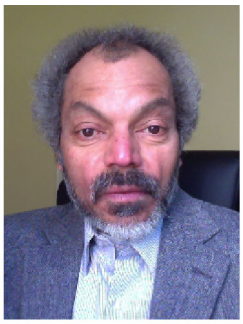

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With an increasing imperative to harness diverse forms of renewable energy, the focus on wave energy has increased considerably over the last two decades. In the struggle to make wave energy commercially viable, many fundamental problems need to be addressed, including to the reciprocating energy flow characteristic of most wave energy converters (WECs), the hostile environment, the need to optimise WEC geometries and arrays, and the desire to optimise WEC device output through the use of control systems. Fundamental to many of these issues is the need for appropriate mathematical models, to facilitate the design and evaluation of various WEC systems and subsystems.

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This special issue contains a selection of papers which address both general and specific aspects of WEC design. The overview given by Stephen Salter (Wave energy: Nostalgic ramblings, future hopes and heretical suggestions) gives an important perspective on the historical development of wave energy technology, providing the basic principles which need to be built on. The paper, in addition to covering virtually all aspects of WEC design, also gives useful suggestions for future wave energy research. The papers by Sun et al. (Linear diffraction analysis for optimisation of the three-float multi-mode wave energy converter M4 in regular waves including small arrays) and McGuinness and Thomas (Hydrodynamic optimisation of small arrays of heaving point absorbers) address the hydrodynamic modelling of connected structures and point absorbers, respectively, and show how these devices can be optimised, both in geometry (Sun et al.) and in arrays (Sun et al. and McGuinness and Thomas).

In the paper of Falcão et al. (Air turbine optimization for a bottom-standing oscillating-water-column wave energy converter), the focus is on the power take-off (PTO) system, which converts the wave motion into useable energy, in this case an air turbine for an oscillating water column (OWC).

This paper is focussed on the task of optimising the aerodynamic efficiency of the air turbine PTO, which is equally important to optimising the hydrodynamic performance of the WEC.

The remaining three papers, by Abdelkhalik et al. (On the control design of wave energy converters with wave prediction), Genest and Ringwood (A critical comparison of model-predictive and pseudospectral control for wave energy devices), and Korde et al. (Wave-by-wave control in irregular waves for a wave energy converter with approximate parameters), address the design of WEC control systems to maximise power capture, via manipulation of the PTO loading on the WEC. All papers use a prediction of the future wave excitation and show how optimal PTO loading can be calculated from the wave prediction and the WEC model. In Abdelkhalik et al., a shape-based approach to optimal PTO loading calculation is used, while the paper by Genest and Ringwood compares the performance and computational characteristics of two popular predictive WEC control algorithms. The paper by Korde et al. calculates a control signal when the device model parameters are only approximately known.

In covering both broad and specific aspects of wave energy system design, we hope that this special issue will be of value to researchers and practitioners alike in the quest for economically viable wave energy.

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Guest Editors